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Satonius jiadongi sp. nov., a new species of torrent beetle from Hengqin Island, China (Coleoptera: Myxophaga: Torridincolidae)

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Abstract: A new species of torrent beetle, *Satonius jiadongi* **sp. nov.**, is described from Hengqin Island, Guangdong Province, China, which is the southernmost species of the genus *Satonius* Endrödy-Younga, 1997 in the world, and the 13th known species of the family Torridincolidae in China. The new species resembles *Satonius panghongae* Liang, Jiang, Bergsten, Jia & Ge, 2024 and *S. xinghuiensis* Liang, Jiang, Bergsten, Jia & Ge, 2024 in having a body length of less than 1.7 mm and male genitalia with strongly reduced paramere bearing only one apical seta. The adult of the new species is diagnosed and illustrated in detail. A brief description and illustrations of its larvae are also provided.

Keywords: taxonomy, Torridincolidae, *Satonius*, new species, South China

中国横琴岛一淘甲科新种——家栋佐淘甲 *Satonius jiadongi* sp. nov.

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摘要：本文描述了采自中国广东省横琴岛的淘甲科 Torridincolidae 一新种——家栋佐淘甲 *Satonius jiadongi* **sp. nov.**，该物种为佐淘甲属 *Satonius* Endrödy-Younga, 1997 已知分布最南的物种，是中国已知的第 13 种淘甲。该新种具较小的体型（体长不超过 1.7 mm），较退化的雄性外生殖器阳茎侧叶，以及阳茎侧叶端部仅具 1 枚端毛，与庞虹佐淘甲 *Satonius panghongae* Liang, Jiang, Bergsten, Jia & Ge, 2024 和新会佐淘甲 *S. xinghuiensis* Liang, Jiang, Bergsten, Jia & Ge, 2024 形态相似。本文提供了成虫详细的鉴别特征、形态描述和图片，以及幼虫的形态简单描述和图片。

关键词：分类，淘甲科，佐淘甲属，新种，华南地区

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Introduction

Torridincolidae, also known as torrent beetles, is the largest family of the suborder Myxophaga, comprising seven genera and 61 described species distributed in southern Africa, South America, and East Asia (Perkins & Bergsten 2019; Bergsten 2022; Liang *et al*. 2024). Among these genera, *Claudiella* Reichardt & Vanin, 1976, *Iapir* Py-Daniel, Fonseca & Barbosa, 1993, and *Ytu* Reichardt, 1973 occur in the Neotropical Region (Araujo Braule Pinto *et al*. 2011; Sampaio & Ferreira 2014, 2018; Sampaio & Short 2018), whereas *Delevea* Reichardt, 1976, *Torridincola* Steffan, 1964, and *Incoltorrida* Steffan, 1973 are distributed in the Afrotropical Region (Shepard et al. 2013; Bilton & Mlambo 2023). *Satonius* Endrödy-Younga, 1997 is the only genus of the family occurring in the Eastern Hemisphere, and has so far been recorded only from mainland China and central to southern Japan (Satô 1982; Jäch 1998; Hájek & Fikáček 2008; Hájek et al. 2011; Liang et al. 2024).

Both adults and larvae of *Satonius* are aquatic and are restricted to rock-face seeps, waterfall margins, and various vertical wet surfaces (Hájek & Fikáček 2008; Hájek et al. 2011; Liang et al. 2024). Some species, e.g., *Satonius kurosawai* (Satô, 1982), show dimorphism in hind-wing morphology, with most individuals having strongly reduced hind wings and some possessing fully developed hind wings (Hájek et al. 2011). Adult *Satonius* can be distinguished from other genera of the family by the following combination of morphological characters: body outline evenly ovate; elytra without serial punctures; antennae 11-segmented; abdominal ventrites not covered by plastron; mesocoxal edge sharply crested (Endrödy-Younga 1997; Hájek & Fikáček 2008). The immature stages of *Satonius* have so far been limited to larval morphology, and the pupal morphology remains unknown. Based on observations of *Delevea* and *Ytu*, the larvae of *Satonius* are presumed to have four instars as well (Hájek & Fikáček 2008).

So far, 13 species of *Satonius* have been described, including one endemic Japanese species *S. kurosawai* (Satô, 1982) and other 12 species known only from mainland China. China is the most species-rich area for the genus, thereby, the Chinese fauna of *Satonius* has been well studied in recent years (Hájek & Fikáček 2008; Hájek et al. 2011; Liang et al. 2024). All known Chinese species are distributed in a range extending from the Qinling Mountains southeastwards to southern China and southwestwards to the Hengduan Mountains, with relatively high species diversity in southeastern China. Some species, such as *Satonius panghongae* Liang, Jiang, Bergsten, Jia & Ge, 2024 and *Satonius jaechi* Hájek, Yoshitomi, Fikáček, Hayashi & Jia, 2011, have relatively wide distributions, whereas others are known only from their type localities, possibly due to limited sampling (Liang et al. 2024). In contrast to the high species diversity of *Satonius* in mainland China, no species of the genus has been reported from surrounding offshore islands, such as Taiwan Island, Hainan Island, or numerous inshore islands in the Pearl River Delta region. The species described in this study represents the first record of *Satonius* from a Chinese inshore island.

Material and methods

Both adults and larvae were collected from a vertical rock-face seepage. Since only one species of *Satonius* was found in this habitat, we determined that the larvae and adults belong to the same species. Specimens were then fixed directly in the field in 95% ethanol and brought back to the laboratory. For photography, photographs of the genitalia were taken using a Zeiss AxioCam HRc camera mounted on a Zeiss AX10 microscope with AxioVision SE64 software. The images were then stacked in Helicon Focus v. 7.0.2. Habitus photographs were taken using a Nikon DS-Ri2 camera mounted on a Nikon SMZ25 stereomicroscope; image layers were captured and stacked using NIS-Elements software. SEM photographs were taken with a Phenom Pro scanning electron microscope using uncoated specimens in low-vacuum mode. Habitat images were taken using a Canon 7D digital camera equipped with a Tamron 90 mm f/2.8 macro lens. Line drawings of the male genitalia were prepared using GoPaint software.

Most adult specimens were dry-mounted. Male genitalia were mounted in soluble glue (fish glue after clearing treatment) on a piece of paper card attached beneath the dissected specimen. Larval specimens and several adult specimens were preserved in 95% ethanol and stored in a freezer at −20°C. All specimens are deposited in the

Biological Museum, Sun Yat-sen University, Guangzhou, China (**SYSU**). Label data of the specimens are cited verbatim and enclosed in double quotation marks; a slash separates different rows on the same label, and a double slash separates different labels. Morphological terminology used in the description follows Hájek & Fikáček (2008) and Liang et al. (2024).

Taxonomy

Satonius jiadongi sp. nov. 家栋佐淘甲

https://zoobank.org/CB77F246-956D-4F16-BA0E-A4C9F6D416A4

Figs 1A, B, 2A−H, 3A, B, 4A, B, 5A−D

Type material. Holotype: male (adult), "China: Guangdong Prov., Zhuhai City, Dahengqin Island, on vertical rock-face seepage, 22°06'38.5"N 113°31'07.5"E, 320 m, 10.VI.2026, Zu-Qi Mai, Jia-Dong Yin, Wei-Cai Xie & Jian-Feng Yu leg." **Paratypes:** 50 spec. (adults), 15 spec. (larvae), same data as the holotype [10 adults and all larvae stored in 95% ethanol].

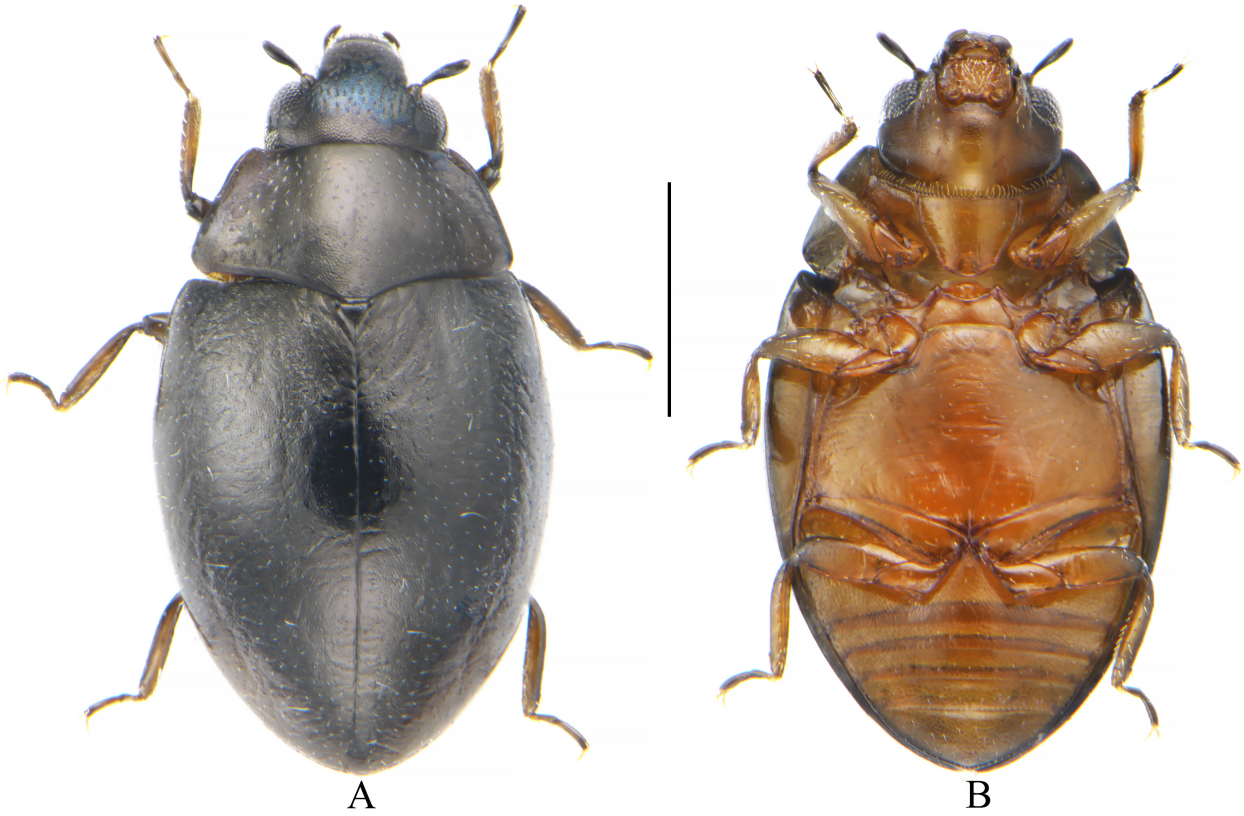

FIGURE 1. Habitus of *Satonius jiadongi* **sp. nov.** (adult): **A** dorsal view **B** ventral view. Scale bar: 0.5 mm.

Diagnosis. Length 1.3−1.6 mm (Fig. 1A, B). Body elongate oval. Dorsum black and dull, ventral surface light yellowish to reddish brown (Fig. 1A, B). Dorsal surface of head and pronotum with sparse and rather coarse setigerous punctures, interstices with distinct microreticulation (Fig. 2C, D). Elytra surface somewhat rugose, covered with fine setae, interstices with dense and tiny dots (Fig. 2E). Pronotum broadly rimmed laterally. Lateral rim of elytra only visible basally and posterior third from above. Hind wings well developed. Apical angle of metatrochanter not extended, forming an obtuse angle (Fig. 2H). Aedeagus (Fig. 3A, B) with median lobe moderately slender, simply curved and gradually narrowing towards apex; parameres strongly reduced, ca. 1/6× as long as median lobe, with only one apical seta, lateral side of parameres with a short field of pores basally. Larva broad and strongly flattened, broadest at mesonotum; abdomen with 8 pairs of long tube-like projections. Dorsum yellowish brown to dark brown, pale yellow ventrally.

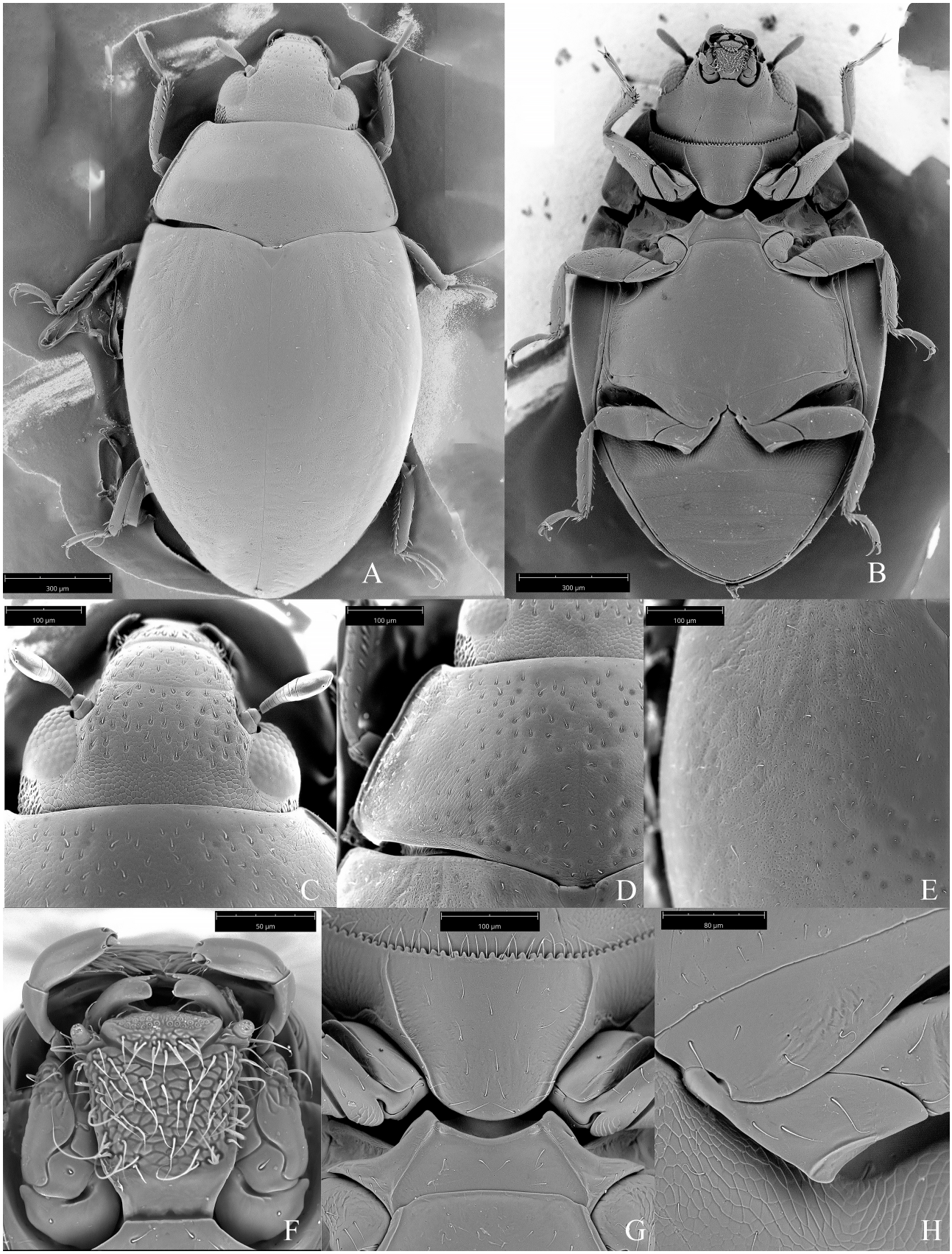

FIGURE 2. SEM photos of *Satonius jiadongi* **sp. nov.** (adult): **A** dorsal view **B** ventral view **C** dorsal view of head **D** pronotum **E** surface of elytron **F** ventral view of mouthparts **G** prosternal process and mesoventral plate **H** metacoxae and metatrochanter.

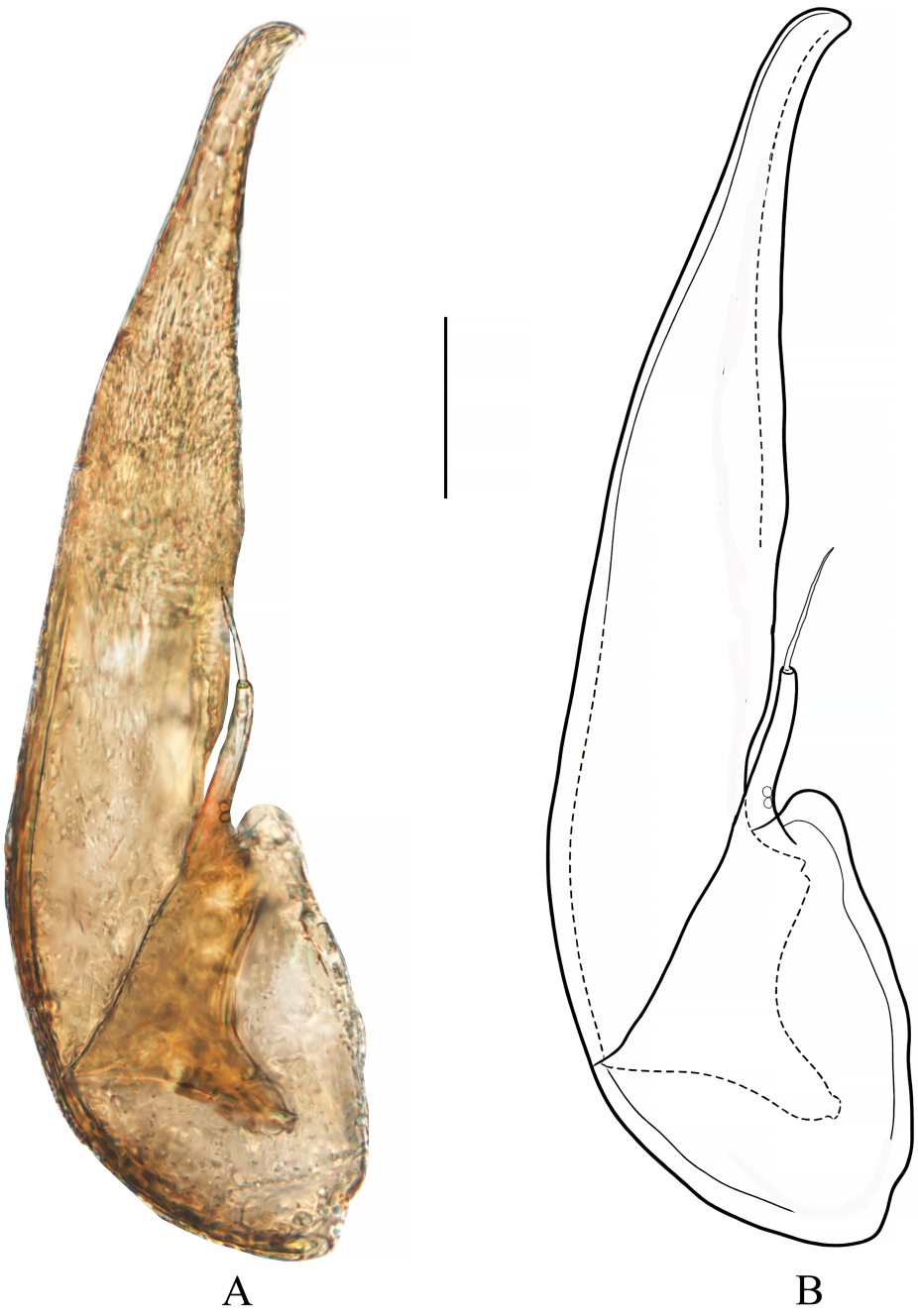

FIGURE 3. Aedeagus of *Satonius jiadongi* **sp. nov.** (lateral view): **A** microscopic image **B** line drawing. Scale bar: 0.05 mm.

Differential diagnosis. This species is similar to *Satonius panghongae* Liang, Jiang, Bergsten, Jia & Ge, 2024 and *S. xinghuiensis* Liang, Jiang, Bergsten, Jia & Ge, 2024 in having a body length of less than 1.7 mm, elytral lateral rim only visible basally and posterior part from above, and male genitalia with strongly reduced paramere bearing only one apical seta. It can be distinguished from *S. panghongae* by dorsum black (dorsum dark brown in *S. panghongae*), dorsal surface of head and pronotum with rather coarse setigerous punctures (with very fine setigerous punctures in *S. panghongae*), median lobe of aedeagus moderately slender (Fig. 3A, B) (median lobe rather slender in *S. panghongae*, see Fig 4A in Liang et al. 2024). It can be distinguished from *S. xinghuiensis* by median lobe of aedeagus moderately slender and gradually narrowing towards apex (Fig. 3A, B) (median lobe rather slender and slightly expanded apically in *S. xinghuiensis*, see Fig 4D in Liang et al. 2024).

Description of adult. *Form and Colour* (Fig. 1A, B). Total length 1.3−1.6 mm; maximum width 0.7–0.8 mm. Body elongate oval, moderately convex. Dorsum black and dull, ventral surface light yellowish to reddish brown. Antennae and maxillary palpi dark brown to black. Legs with ventral surface yellowish to reddish brown; extreme apex of femora, basal part of tibiae and tarsomeres dark brown to black.

Head. Frons with sparse and rather coarse setigerous punctures; interstices between punctures with distinct microreticulation composed of polygonal meshes (Fig. 2C). Eyes large and rather protruding, separated by 3.0× of width of one eye. Clypeus ca. 2.5× as broad as long, surface with setigerous punctures finer than those on frons. Frontoclypeal suture transverse, finely traced (Fig. 2C). Labrum with long stiff setae along anterior margin. Antenna with 11 antennomeres, short, club-shaped; Scapus robust, with an apical sensillum anteriorly; pedicel smaller, stout, with a smaller sensillum; antennomeres III−X compact, without any distinct sensilla; antennomere XI long, about 4× longer than preceding antennomere, with two pore-like sensilla dorsally (Fig. 2C). Maxillary palps with 3 palpomeres; palpomere I shortest; palpomere III longest, as long as palpomeres I−II combined, with a stout conical sensillum apically and three fine sensilla subapically (Fig. 2F). Mentum longer than wide, surface with dense microreticulation and long stiff setae (Fig. 2F). Labial palps very short, with 2 palpomeres (Fig. 2F).

Thorax. Pronotum widest posteriorly, gradually narrowed anteriad, with similar setigerous punctures and microreticulation to those on head (Fig. 2D). Lateral margins of pronotum broadly rimmed, anterior and posterior margins without rim. Prosternum with crenulate anterior margin (Fig. 2G). Prosternal process broad with arcuate posterior margin (Fig. 2G). Scutellar shield small, triangular. Elytra without any striae; lateral rim of elytra only visible basally and posterior third from above (Fig. 2A); elytra surface somewhat rugose, covered with sparse and fine setae, interstices with dense and tiny dots (Fig. 2E). Epipleuron with a large basal cavity; wide in anterior half, then abruptly narrowing and narrow in posterior half (Fig. 2B). Mesoventral plate hexagonal, wider than long; surface of mesoventral plate with very sparse fine setae; its anterior margin concave for reception of prosternal process, lateral angles projecting into spines (Fig. 2G). Metaventrite large, with two mesocoxal cavities anterolaterally; surface of metaventrite with very sparse fine setae. Hind wing well developed. Pro- and mesocoxae suboval, metacoxae transverse and large; protrochanter with three semi-erected setae; mesotrochanter with four setae; metatrochanter with three semi-erected setae, apical angle of metatrochanter not extended (Fig. 2H).

Abdomen. Abdominal ventrites I−V visible, surface with distinct microreticulation composed of polygonal meshes. Aedeagus (Fig. 3A, B) with median lobe moderately slender, simply curved and gradually narrowing towards apex in lateral view; phallobase large; parameres strongly reduced, ca. 1/6× as long as median lobe, with only one apical seta, lateral side of parameres with a short field of pores basally.

Description of larva (Fig. 4A, B)**.** Body broad and strongly flattened, broadest at mesonotum; abdomen with 8 pairs of long tube-like projections. Dorsum yellowish brown to dark brown, pale yellow ventrally. Head not concealed by pronotum; slightly wider than long. Frontal suture distinct. Antenna with 2 antennomeres; antennomere I very short; antennomere II ca. 6× as long as antennomere I. Ocellar protuberance, with 4 stemmata. Mandibles covered by labrum, symmetrical. Thorax almost as long as abdomen. Pronotum almost as long as head, ca. 2× as wide as head. Meso- and metanotum almost the same length and width, shorter and slightly wider than pronotum. Lateral margins of all thoracic segments with fringe of alternating long and shorter hair-like setae. Legs with 4 segments and a claw. Prothoracic legs shorter than meso- and metathoracic legs. Abdomen with 10 segments; segment I slightly narrower than metanotum, each following segment slightly narrower than the previous one; segments I-VIII short and transverse, projecting into lateral processes. Lateral processes bearing long, two segmented tracheal gills; first gill segment very short on abdominal segments I-V, slightly longer on abdominal segment VI and rather longer on segment VII-VIII; second gill segment with secondary subapical constrictions. Lateral processes with few spine-like setae at base of tracheal gills. Abdominal segment IX bearing pair of fixed urogomphi; each urogomphus with several long hair-like seta. Abdominal segment X developed as pair of membranous ventral flaps posteriorly to sternite IX.

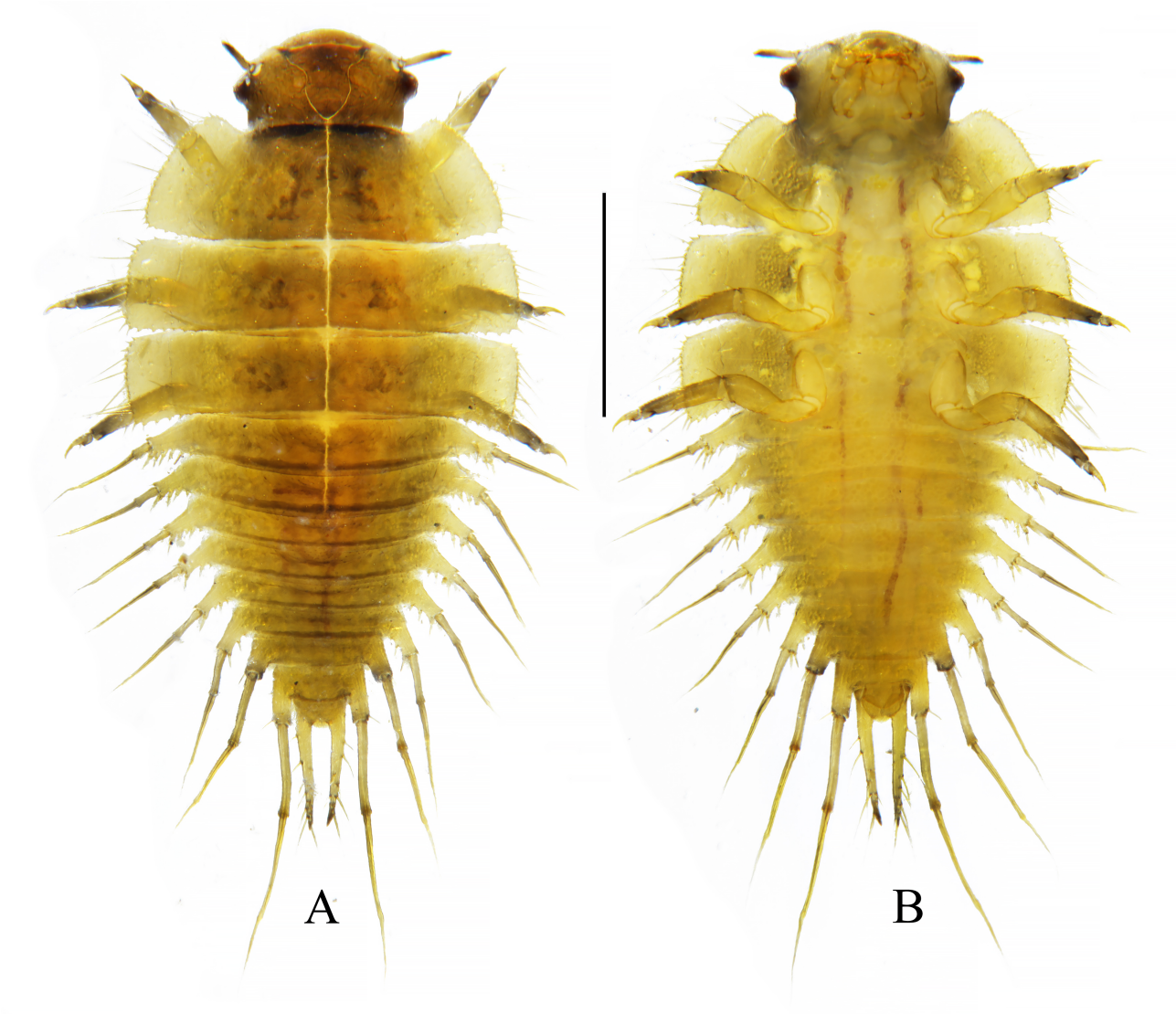

FIGURE 4. Habitus of *Satonius jiadongi* **sp. nov.** (larva): **A** dorsal view **B** ventral view. Scale bar: 0.5 mm.

Biology (Fig. 5A−D)**.** Both adults and larvae were collected from an exposed, vertical rock-face seepage along a mountainside, a habitat exposed to direct sunlight at midday and lacking abundant higher plants and root systems. Adults often exhibit thanatosis by retracting their legs against the ventral surface. They co-occur with other aquatic beetles belonging to Hydrophilidae, Hydraenidae, Psephenidae, and Dryopidae.

Etymology. The species is named in honor of Dr. Jia-Dong Yin (SYSU), a specialist on Miridae and one of the collectors of the type specimens, in appreciation of his help during the author's fieldwork.

Distribution. China (Guangdong), only known from type locality.

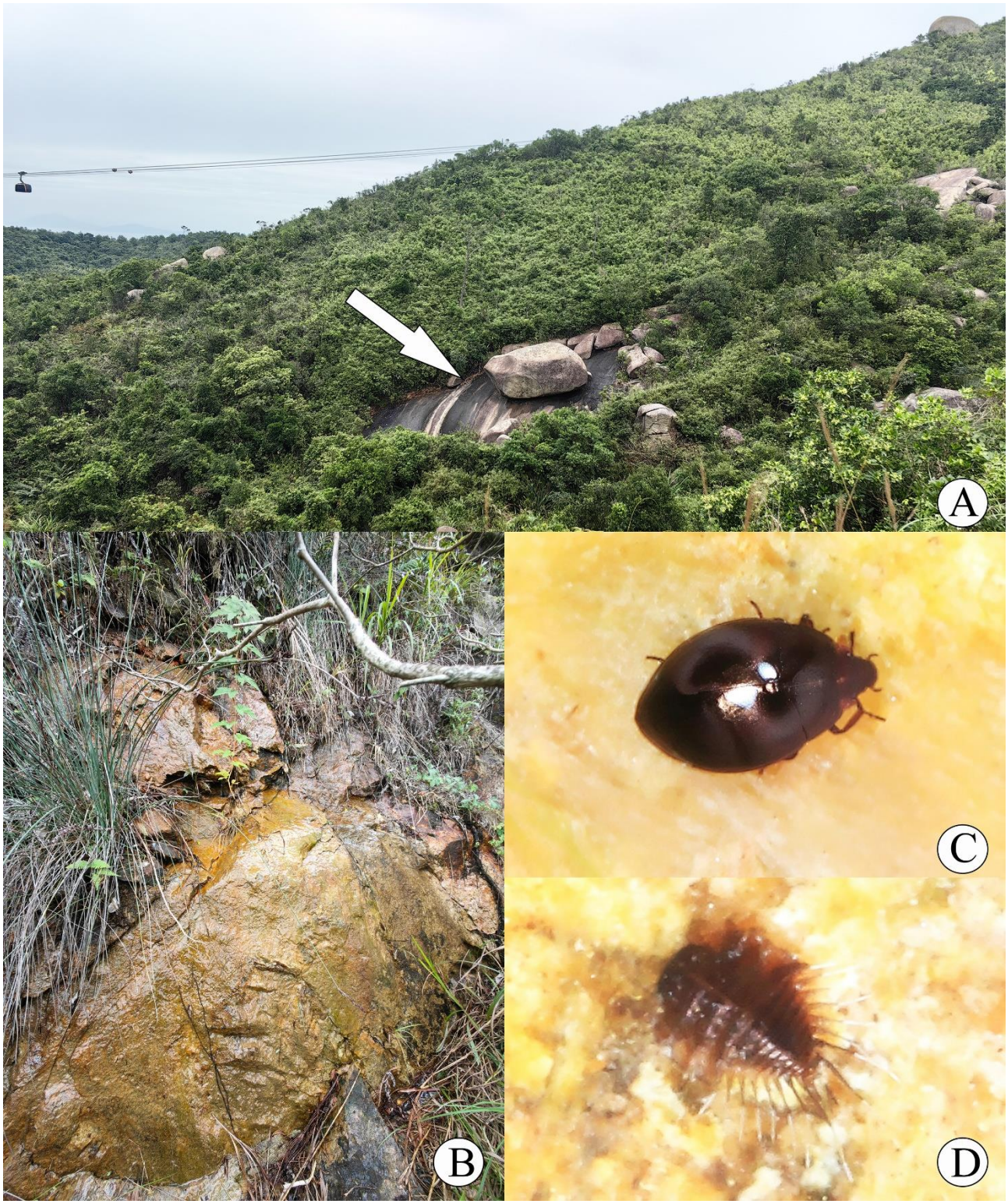

FIGURE 5. Habitats of *Satonius jiadongi* **sp. nov.**: **A** Dahengqin Mt. (arrows indicate flowing water and stone walls) **B** vertical rock-face seepage **C** adult **D** larva.

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Additional information

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Ethical statement: No ethical statement was reported.

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